



SATELLITE
RADIO

NASA Knowledge Transfer



HEADS UP TECHNOLOGIES

What is XM Satellite Radio?

Radio to the Power of X

- **Subscription Radio Service for Car, Home, and Portable Devices**

- Over 120 Channels of Music, News, Sports and Entertainment
- Coast-to-Coast Coverage of the Continental U.S.
- Superior Digital Sound Quality
- Text Display - *channel name, channel number, artist and song title*
- \$9.99 per month

TAKE XM EVERYWHERE.
THE ONLY SATELLITE RADIO FOR CAR, HOME OR BOOMBOX.

SKYFi Portable Boombox
SA10001

The New DELPHI XM SKYFi Radio.

SKYFi Receiver SA10000
Remote included. Required Home, Vehicle Adapter Kit or SKYFi Portable Boombox Sold Separately.

SKYFi Home Kit and Antenna
SA10004

SKYFi Car Kit and Antenna
SA10002

"Simply the best satellite radio around."
— Wall Street Journal, 1/24/03



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Compelling Programming

Award-Winning Staff & Shows

National Consumer Brands



Renowned Programming Staff

- 1,250 Years of Radio Experience
- 300 Gold Records
- 62 Record Industry Awards
- 2 Emmy Awards
- 1 Rock and Roll Hall of Fame
- 4 New York Festival Awards



Live and Event Programming

XM Live.

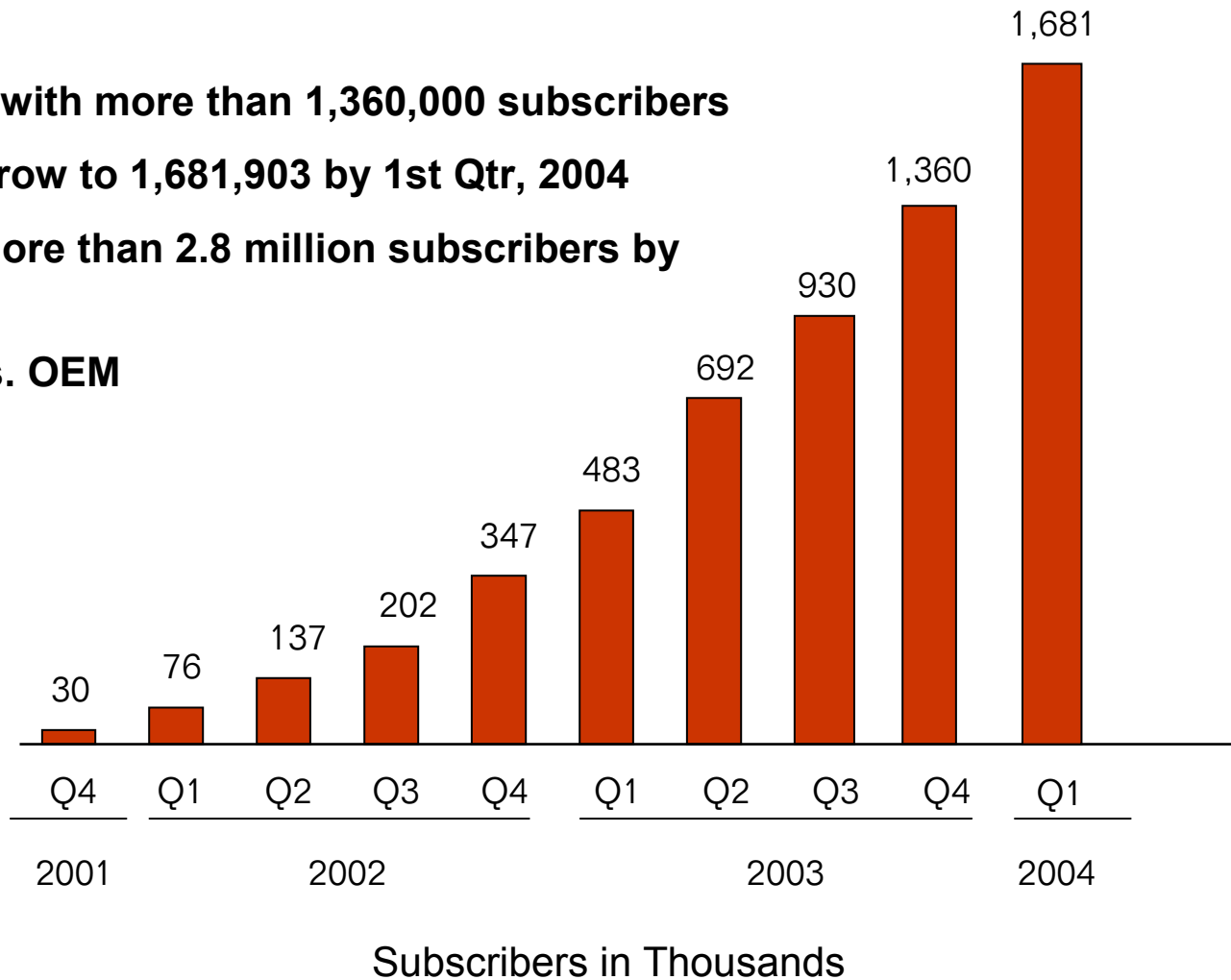


Shows and Specials



XM Subscription Growth

- XM ends 2003 with more than 1,360,000 subscribers
- Subscribers grow to 1,681,903 by 1st Qtr, 2004
- XM projects more than 2.8 million subscribers by the end of 2004
- 50/50 Retail vs. OEM



XM's Automotive Partners

Automobile Manufacturers



Automotive Radio Manufacturers



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XM Specialty Partnerships

Niche Markets

✓ Rental Cars...



✓ Marine...



✓ Trucking Fleets...

FREIGHTLINER®
CORPORATION

A DaimlerChrysler Company



PANA-PACIFIC



✓ Aviation...



XMR100 - XMR800 Aviation Receiver



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Solutions. Now.

jetBlue AIRWAYS® airTran AIRWAYS



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6



XM for Aviation - Heads Up's Cabin Class Solution

Multiple Receiver Configurations:

1, 2, 4, 8 receiver LRU

RS485, CAN, RS232, Discrete, and

ARINC 429 Interfaces

Partnering w/Cabin Management Providers



STC'd on Raytheon Premier,

Bombardier Global Express, and

Cessna CJ2



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The XM System



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Unrivalled Signal Delivery Capability



- Un-interrupted CONUS coverage
- Un-rivaled service availability
- S-Band XM Signal robustness
- Exceptional XM Signal strength
- XM Terrestrial Repeater Network
- Space, Frequency & Time Diversity
- Proven, low cost XM Receivers already in high volume production
- Small, omni-directional XM Antennas
- End-to-end All-Digital system
- State-of-art XM Broadcast Facility

XM provides optimum solution for data broadcast to mobile & fixed receivers



Satellite – Characteristics

Prime Contractor

Spacecraft Platform

Orbital Locations

Operational Life

Peak EIRP

End of Life Power

Liftoff Mass

Hughes

HS-702

85°W and 115° W

15 years

68 dBW

15 kW

4650 kg

Payload Supplier

Payload DC Power

Frequencies

Reflectors

TWTA Power

Channelization

TWTAs

Alcatel

13.5 kW

X-Band Up, S-Band Down

Two 5 meter shaped reflectors

220 W each

2 TDM channels

16 paralleled TWTAs per TDM channel

4 x 11 for 8 redundant TWTAs

216 W RF power each

over 55% DC to RF efficiency

Receivers

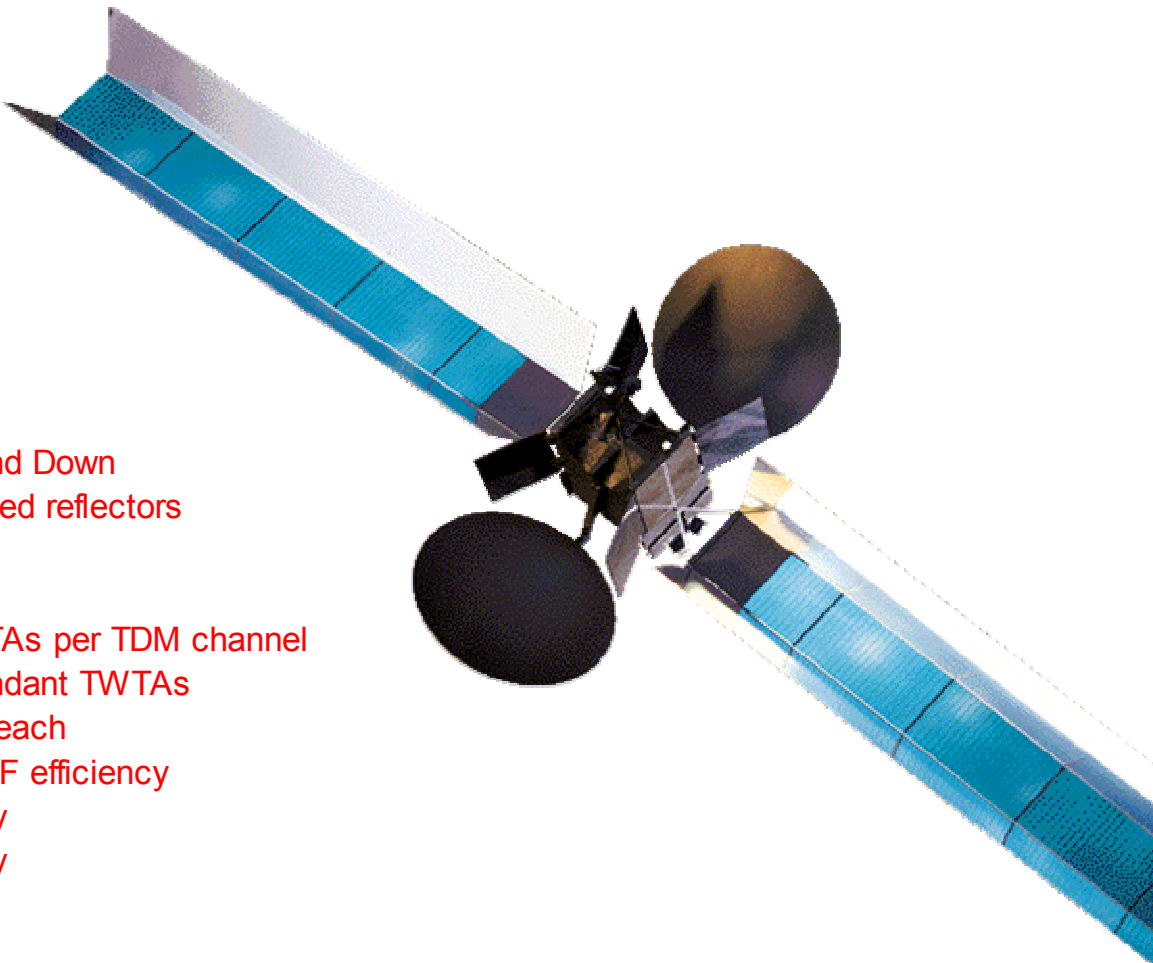
4 for 1 redundancy

IF Demultiplexers

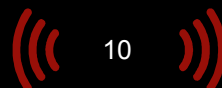
4 for 2 redundancy

Launch Vehicle

Sea Launch



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10





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NASA
Support



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NASA Knowledge Transfer

- 1) NASA gives “Crash Course” to Heads Up on Aviation Weather Communications
- 2) NASA Supports Heads Up Presentation to XM Sr. Management
 - Aviation Weather Problem
 - S-DARS Weather Link Experiment (1999 via Afristar Satellite)
 - ODU Market Study
- 3) NASA Supports Heads Up Presentation to XM Technology Group
- 4) NASA Supports Heads Up Presentations to Aircraft OEMs





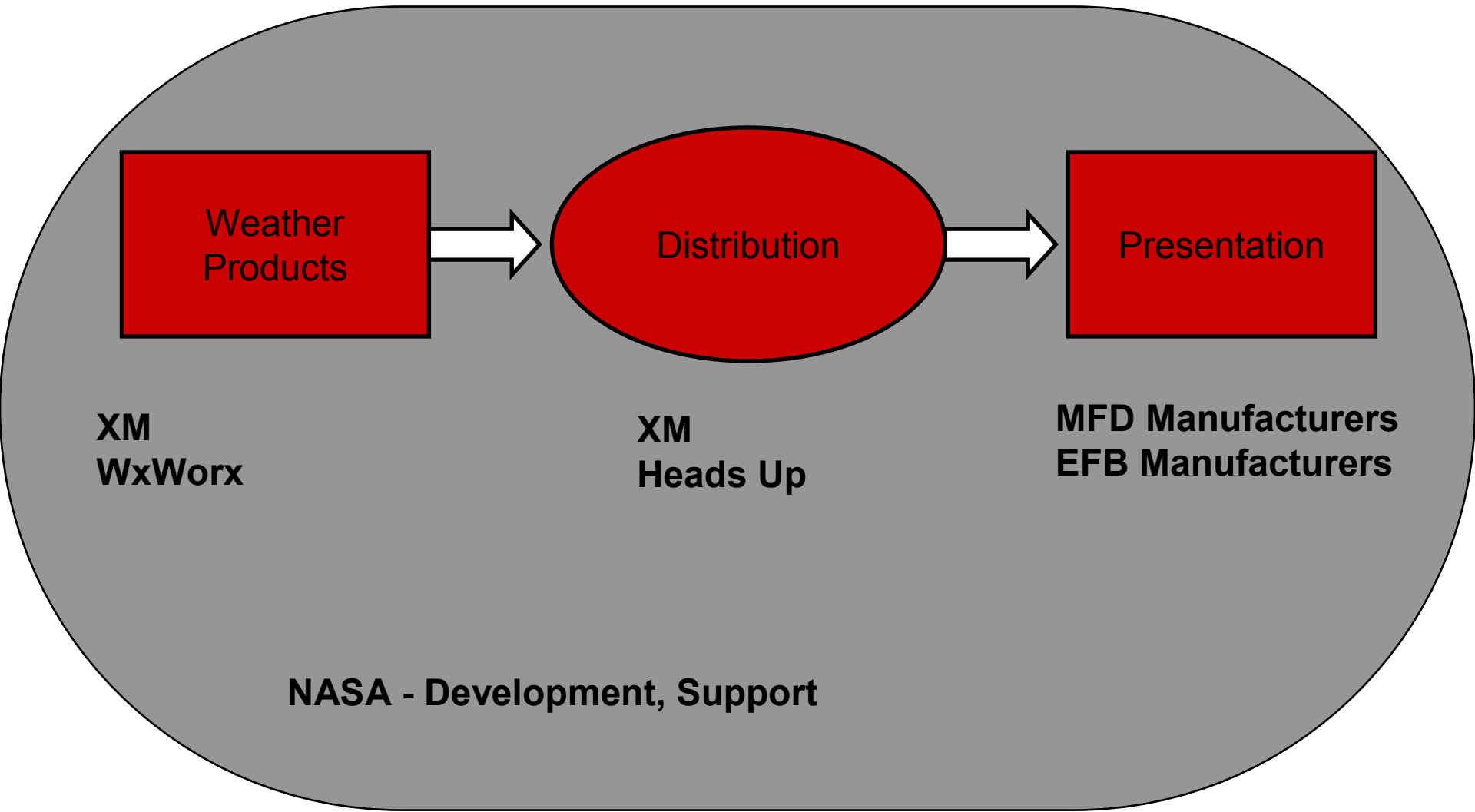
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**XM WX
Satellite
Weather**



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Model for Proposed XM Weather Team



WxWorx: A Specialized Weather Company

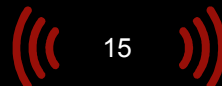
- Subsidiary of Baron Services, Inc.
- Weather provider of choice to weather-dependent professionals
 - Emergency Management
 - TV Meteorologists
- Ideal “fit” with XM
 - Best Mobile Weather (WxWorx)
 - Best DataLink (XM)



WxWorx[™]



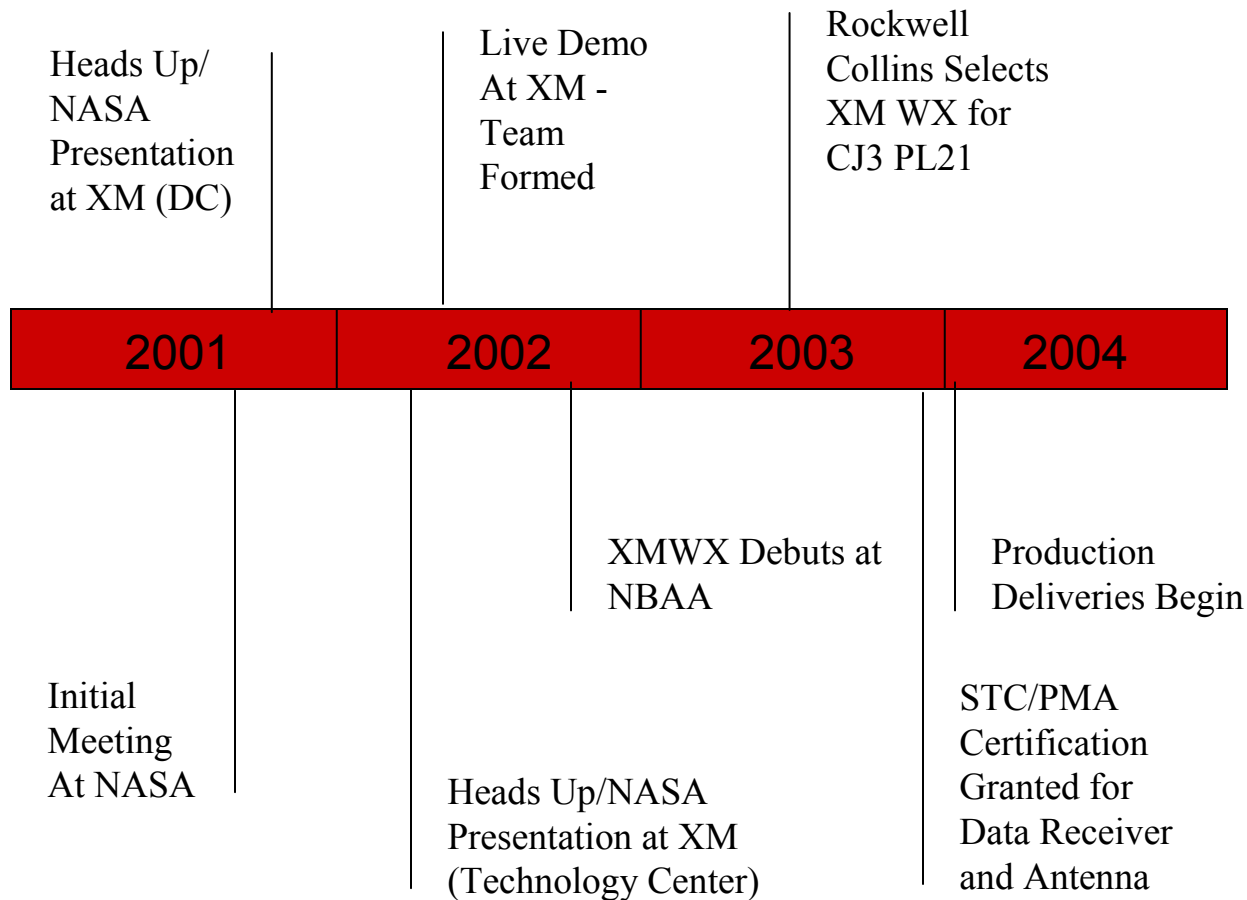
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15



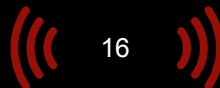
Development Timeline



28 Month Concept-to-Production



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16



XM WX Receiver Options



FAA Certified Receiver/
Antenna/ Cockpit Data Port



Portable Data Receiver
(not FAA Certified)

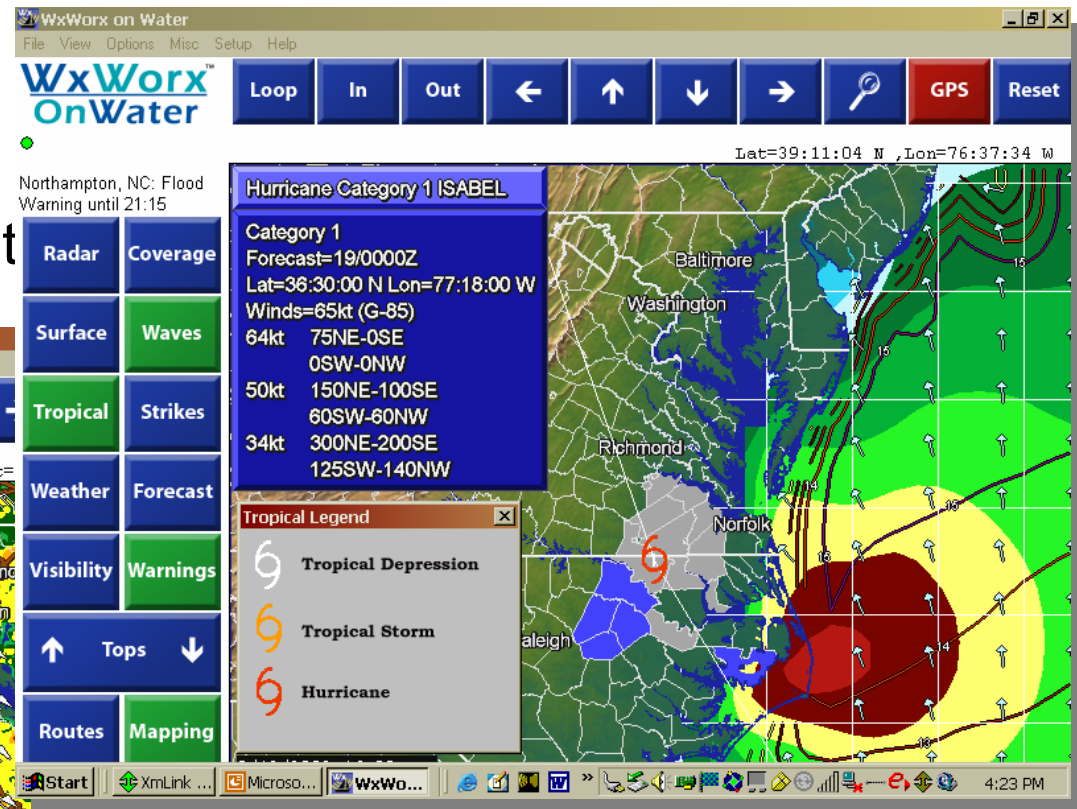
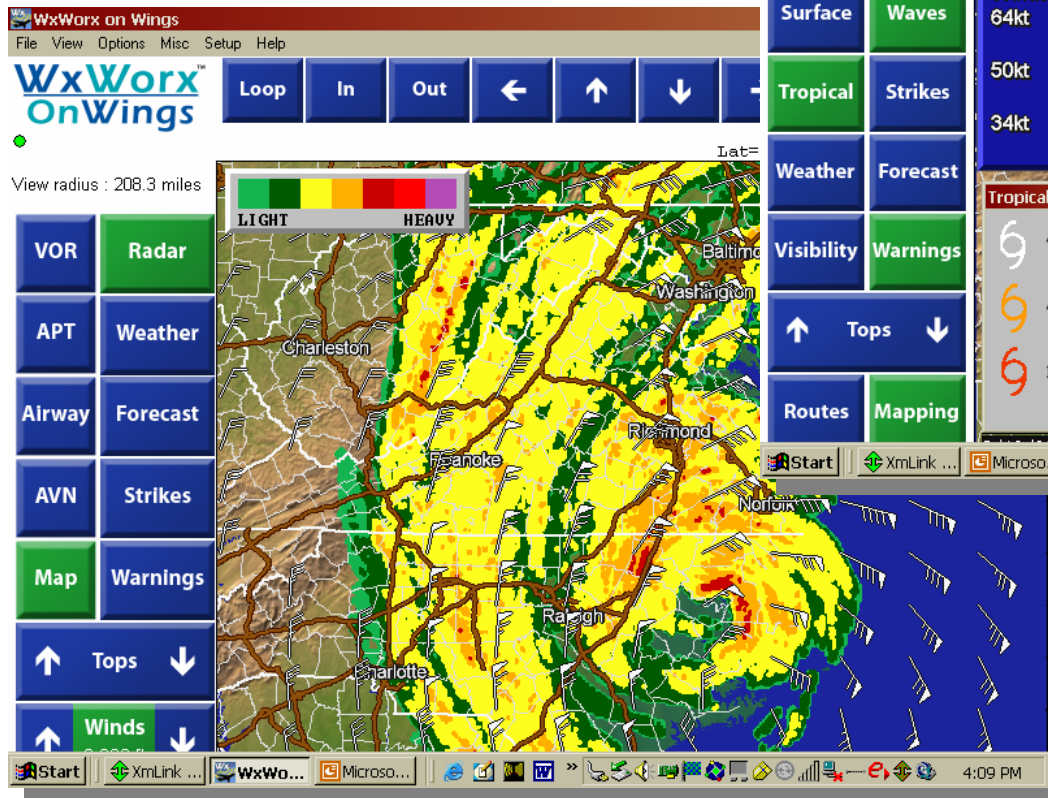
XM WX Weather Products

Weather Product(s)	Aviator \$49.99	Master Mariner \$49.99	Responder \$99.99
NexRad (High Resolution and Coverage)	X	X	X
METARs, TAFs	X	X	X
County Warnings, City Forecasts, Surface Analysis	X	X	X
Lightning, Storm Cell Attributes	X	X	X
SIGMETs, AIRMETS, Echo Tops, Winds Aloft, and TFRs	X		X
Surface Wind Speed/Direction, Pressure, Sea Surface Temperature		X	X
Wave Height, Direction, and Period		X	X
Buoy Data, Hurricane Track, Visibility Forecast, Precipitation Type		X	X

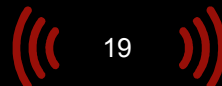


XM WX Software Applications from WxWorx

Aviation, Marine, and
Emergency Management



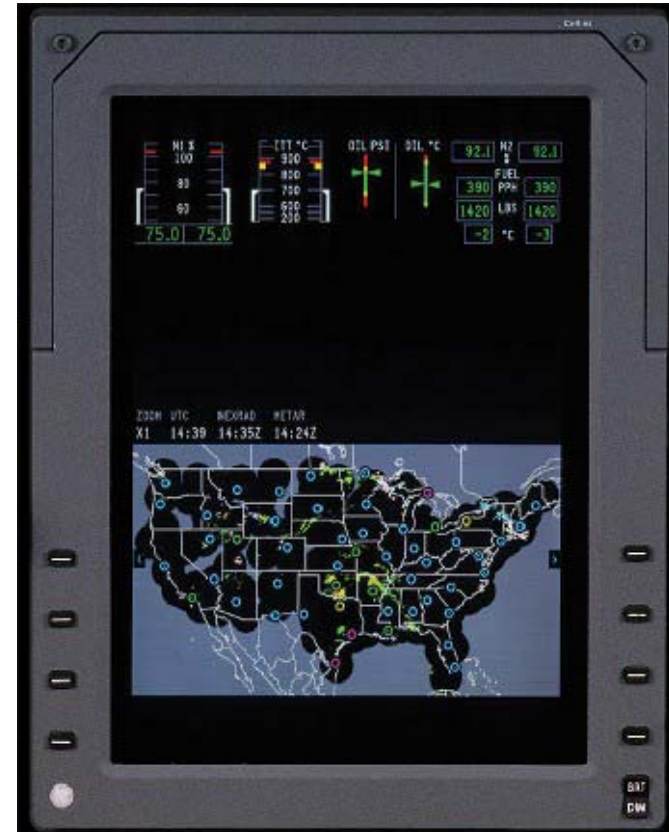
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19



Rockwell Collins



Sample of NEXRAD and METARs on MFD

Summary

- NASA's Support was a critical element of the XM WX Program
 - Established confidence in the business model
 - Provided technical requirements and evidence of feasibility
 - Shortened development time to 28 months (concept to production)
- Data Receivers and Antennas FAA Certified
- Several EFB solutions flying today
- Several MFD Manufacturers including Rockwell Collins and Garmin have selected XM WX.



Future Research & Technology Needs

- Additional Weather Products and Tiers.
- Combination of Weather Data and Non-Weather Data.
- Combination of Request Reply and Broadcast Data link architectures.

